BCLDP GROUNDWATER PLAN

WEST JEFFERSON NORTH SITE

March 12, 2003 (Revision 2)

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1.0 BACKGROUND

During March and April, 2002 Battelle conducted an assessment of the groundwater situation at the West Jefferson North Area. A summary of the assessment was captured in a PowerPoint® presentation entitled, Battelle West Jefferson North, 2002 Groundwater Assessment, May 3, 2002. The outcome of that assessment was the initiation of a new phase of groundwater characterization activities for evaluating the potential of subsurface pathways to transmit contaminants to on-site and off-site receptors. Secondly, the characterization activities would also provide the information necessary for the design of dewatering systems around the JN-3 and JN-1 building foundations needed during demolition of the buildings. Over time this plan will be revised and expanded and will also include the design and operation of those systems. The groundwater plan will be updated and expanded prior to the initiation of each new phase of field activities and as a minimum, updated annually. This is the first revision of the Groundwater Plan. It is based on information and data gathered during the summer FY-02 characterization and monitoring activities captured in a PowerPoint presentation entitled, Battelle West Jefferson North 2002 Groundwater Update, September 27, 2002.

2.0 OBJECTIVES

The purpose of the Groundwater Plan is to provide a narrative for future groundwater activities of the current baseline as documentation of BCLDP project planning. The plan assumes a working knowledge of the geology and hydrology of the site. The intent is to provide details for the next field phase of groundwater characterization. Future activities following the baseline diagram shown in Figure 1 will be described in detail as characterization progresses. This approach is necessary because the plan will build on itself as information becomes available through near-term characterization activities.

3.0 SUMMER FY2002 FIELD ACTIVITIES

During the remainder of FY2002 wells were installed for use in defining the shallow groundwater flow system in the north and east portions of the site and to determine the hydraulic properties of the 885- and 855-sands. Larger diameter wells installed around JN-3 were used for hydraulic testing and will soon be used as dewatering wells for the JN-3 floor drain removal activities. The summer 2002 phase of drilling included the installation of:

- Three 885-sand layer monitoring wells (30 ft deep),
- Three 855-sand layer monitoring wells (60 ft deep), and
- Four 885-sand dewatering wells around JN-3, 2 of the wells now have submersible pumps (30 ft deep).

Boreholes were drilled and soil was sampled at four other locations, but wells were not installed. These included 3 boreholes, each 15 feet deep, into the till and one borehole 30 feet deep into the 885 horizon.

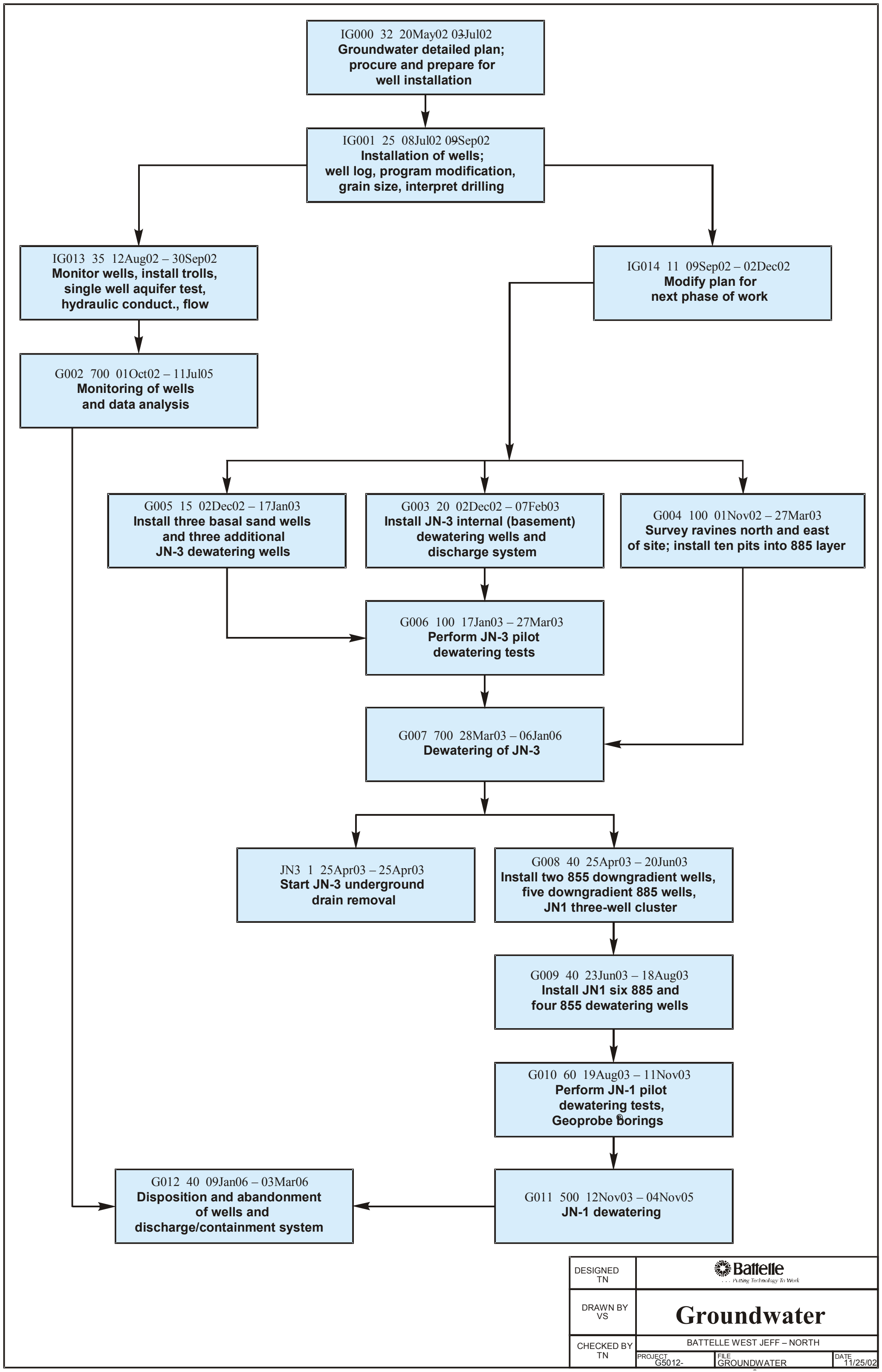

Figure 1. Baseline diagram for groundwater activities.

3.1 Shallow Till Monitoring Borings

Six shallow till monitoring wells were planned for installation to the north and east of the West Jefferson North buildings. The wells were aimed at supplementing the existing shallow well network by allowing characterization of shallow groundwater flow conditions in the northern portions of the site. The planned drilling locations are shown in Figure 2. Borings 15-20 feet deep were augured only at the number 2, 4, and 5 locations. Split spoon samples were taken from an elevation of 880 to 890 in the number 5 location. Wells were not completed in any of the 3 borings because of the nearly absent sand and silt deposits in the 885 ft elevation horizon at the locations.

3.2 885-Sand Monitoring Wells

Three wells were installed in the 885-sand at distances of approximately 400 feet from one another. The wells will be approximately 30 ft deep. The well locations were selected in order to triangulate water levels in the unit and provide information on groundwater flow in the unit. Ground surface elevations at the well locations were surveyed before well installation in order to accurately log the sand unit(s). Split spoon sampling was performed at one-foot intervals from approximately 20-30 ft below ground surface in the elevation interval 880 to 890 feet. Figure 2 shows the planned locations of these 3 wells, while figure 3 shows the installed locations of the number 1, 2, and 4 wells. The number 3 location was moved toward the west and across the main access road. It was augured, but because of the absence of the sand unit a well was not constructed.

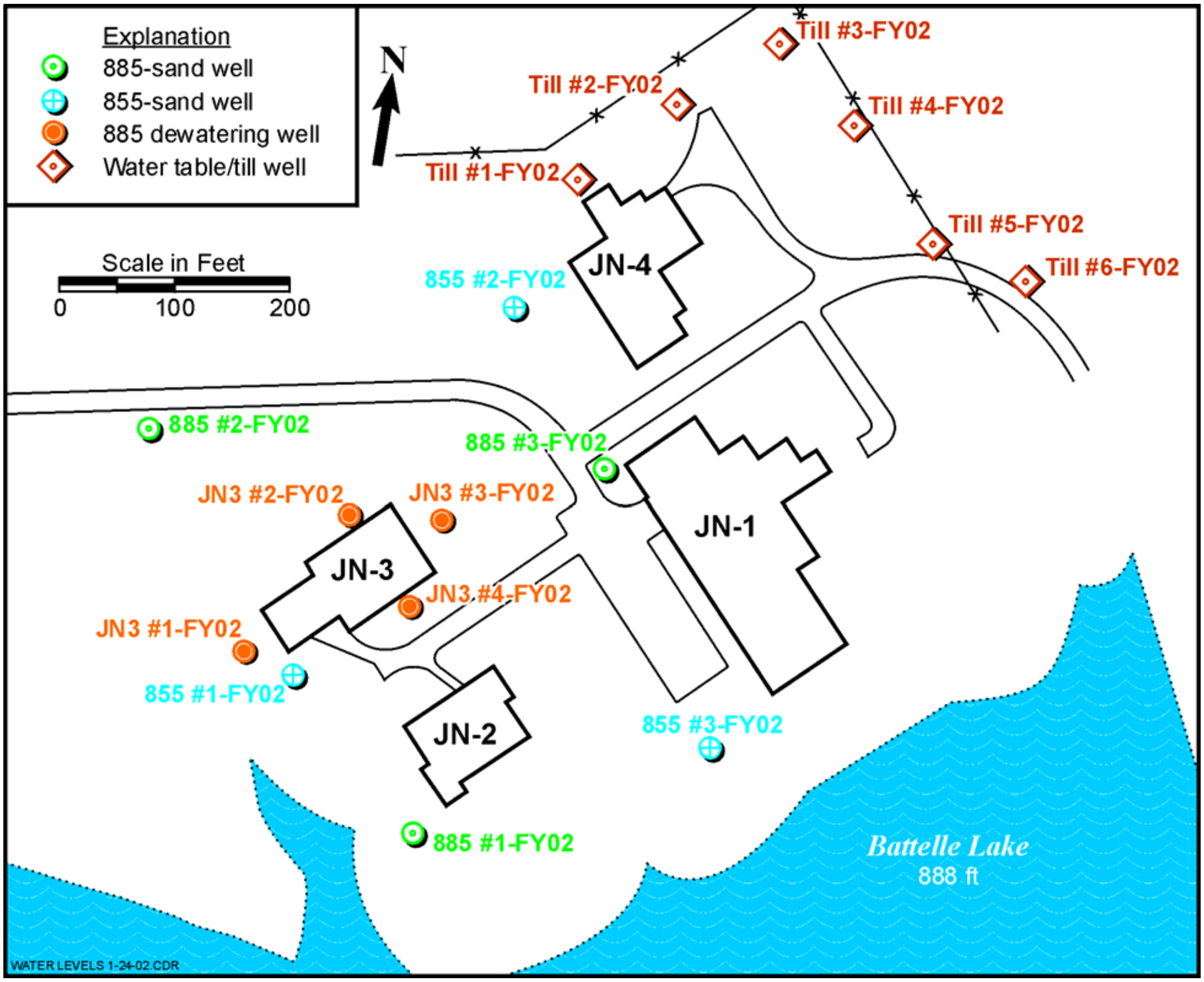

Figure 2. Planned locations and identification numbers of FY02 wells.

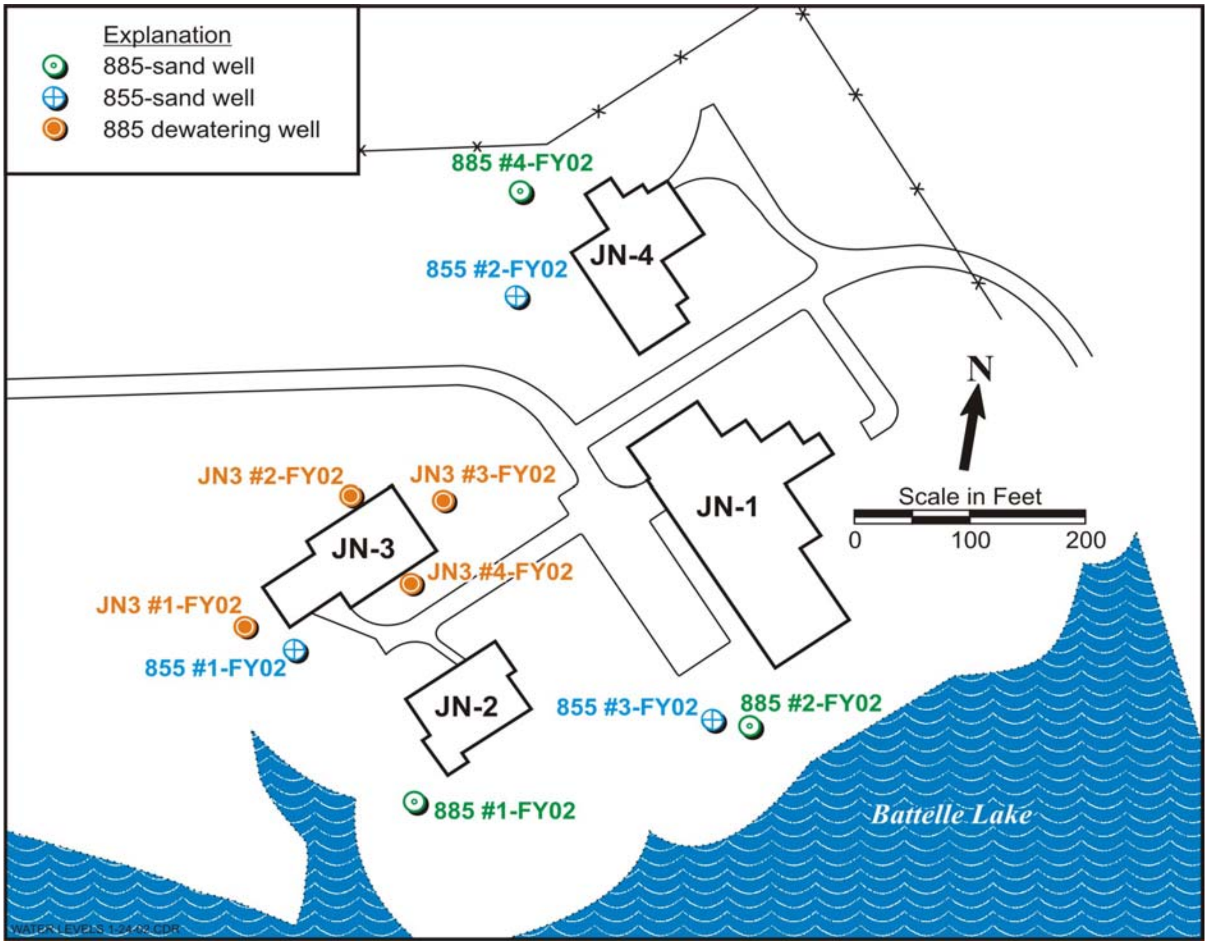

Figure 3. Locations of wells installed during the summer of 2002.

3.3 855-Sand Monitoring Wells

Three wells, 400 feet apart, were also installed at the site in the 855-sand. The wells were 60 ft deep. Well locations were selected to triangulate water levels in the sand unit and provide information on groundwater flow in the 855-sand. Split spoon sampling was performed at one-foot intervals from approximately 20-30 feet below ground surface in these boreholes to confirm the presence of the 885-sand. The triangle for the 855-sand wells had been rotated approximately sixty degrees from the 885-sand well triangle to gain maximum coverage for sampling the 885 sand during this phase of drilling. The two triangles, therefore, will yield split spoon samples for the 885-sand in 6 locations around the JN-1, 2, and 3 area of the site that are roughly 200 feet apart. Additional samples of the 885-sand horizon were taken during the installation of the dewatering wells around JN-3. Split spoon sampling was then performed in the 855 sand wells in one-foot intervals between a depth of 50 and 60 feet.

3.4 Dewatering Wells at JN-3

Four dewatering wells were installed in the 885-sand horizon surrounding JN-3. The purpose of these wells is to pump water from the 885-sand and the till above in order to reduce water levels around JN-3. The dewatering wells will be approximately 30 ft deep with 20-ft long screens to maximize water recovery. Groundwater inflow to these wells has been very slow, on the order of 1 gallon per minute.

Low capacity permanent submersible-pumps have been installed in two of the four dewatering wells. Split spoon sampling was performed from 880- to 890 feet elevation to identify the 885-sand and properly screen the wells. One well was located on each side of the building.

3.5 Well Construction Parameters

Table 1 summarizes the well construction details. Continuous split spoon soil sampling was performed in selected intervals during hollow stem auger (HSA) drilling. The samples were retained for geotehnical testing by the geotechnical contractor and RAL (Radiological Analysis Laboratory) analysis performed by Battelle.

Table 1. Planned well construction parameters.

Description	Number of wells	Approximate Total Depth (feet)	Well Diameter (inches)	I.D. of HSA (inches)	Screen Length (Ft)	Approx. Sampling Intervals (ft bgs)
Shallow Till Borings	TBD	15	4	6.25	5	None
885-Sand Wells	3	30	4	6.25	5	20-30
855-Sand Wells	3	60	4	6.25	5	20-30 and 50-60
885-Sand Dewatering Wells near to JN-3	4	30	Approx. 8	12.25	20	20-30

3.6 Geotechnical Testing

Soil samples were collected and analyzed for geotechnical properties. Analysis included sieve analysis according to ASTM C-117 and C-136 methods. Porosity determinations were also performed on all samples containing obvious sand and silt content.

3.7 Radiological Testing of Soil Samples

Battelle geologists were present during the time when split spoon samples are being retrieved. Individual split spoon samples retained by the geotechnical contractor for grain size analysis were split and composited (from each 10 foot interval) for radiological analysis by Battelle. All soils sampled during this phase of drilling contained only background levels of radiation.

3.8 Surveying

All planned and actual well locations were surveyed for land surface and casing top elevations before and after well installation. The purpose of surveying the land surface before the well installations was to provide information on the probable depths to the sand horizons below ground surface. The results of this work was compiled and included with the well completion and boring logs report.

3.9 Hydraulic Testing

Slug tests were performed in the wells (exhibiting measurable water level recovery within an hour) after completion to determine the hydraulic conductivity of the materials surrounding the wells. The tests consisted of creating an abrupt change in water level within the well then monitoring water level recovery. The slug tests were analyzed with industry-accepted methods and reported in the well completion and boring logs report.

3.10 Well Logs and Reporting (Drilling report submitted on 9/24/02 by DLZ Ohio Inc.)

Formal boring/well logs were provided after the completion of well construction, developing and testing. A complete well completion and boring logs report was prepared to document all activities and results from the contracted work. This report is entitled Well Installation and Geotechnical Testing, West Jefferson North Site, September 24, 2002, prepared for Battelle Memorial Institute.

3.11 Water Quality Analysis

During well development Battelle staff collected water samples each well for radiological analysis. All water samples taken during this phase of drilling contained only background levels of radiation.

3.12 Post-Drilling Hydraulic Testing and Water Level Measurements

After wells are installed Battelle staff performed hydraulic testing of selected new wells as a confirmation of parameters reported in the geotechnical testing report. Automated water level measuring devices (trolls) were installed in the wells during hydraulic testing. Both automated and manual water level measurements were taken in all wells and thousands of measurements were recorded in order to aid in the planning of the FY03 activities.

4.0 FALL FY2003 FIELD ACTIVITIES

The glacial geology of the site is dominated by till deposits. The till has a low hydraulic conductivity and consists of a mixture of mostly clay with silt, sand, gravel and cobles of glacial origin. Within the till, a relatively high conductivity sand and silt layer has been logged in previous borings at an elevation of approximately 885 ft msl. This 885-sand layer is hydraulically connected to Battelle Lake. Another sand unit is present though the site at about 855 ft msl. This unit on average is a few feet thick and more continuous and course than the 885-sand layer. Limestone bedrock is found at about 90-110 ft below the ground surface at the site. A basal sand layer of the glacial deposits lies directly above the limestone at about an elevation of 805 feet mls. This sand, referred to as the 805-sand, will be investigated during the first quarter of FY2003.

4.1 Objectives

The overall purpose for groundwater monitoring and testing at the Battelle West Jefferson North Site is to characterize the groundwater system, particularly in vicinity of buildings JN-1, JN-2, and JN-3. Additionally, the wells will provide a means to assess geologic horizons that may form pathways for migration of contamination. The 805-sand wells will be located in a triangle (Figure 4) in order to determine the horizontal flow direction in the unit below the site. Data from these wells will also be used to determine vertical hydraulic gradients and the degree of hydraulic communication, if any, with the 855-sand layer and with other hydraulic influences. Dewatering wells will be installed around the former subsurface water storage tank on the northeast side of JN-3. Current data collection efforts have indicated this as an area of high infiltration. These wells in conjunction with existing JN-3 wells are installed to reduce groundwater levels below excavation depths of the building. Therefore the following 6 wells will be installed:

- Three 805-sand layer monitoring wells (110 ft deep),
- Three 885-sand dewatering wells around JN-3 (30 ft deep).

Table 2 summarizes the well construction details. Continuous split spoon soil sampling will be performed in selected intervals during hollow stem auger (HSA) drilling. The samples will be retained for geotehnical testing and any required RAL (Radiological Analysis Laboratory) analysis to be performed by Battelle. Geotechnical testing to be included in the bid will consist of porosity determination and grain size analysis (ASTM C-117 & C-136). Once the wells are completed, hydraulic (slug) testing will be performed in the 805-sand wells to determine the hydraulic conductivity of the unit, also to be included in the bid. In general, the portions of the site where this work will be performed contain paved roads and the area is flat. The planned start time for this work is early to mid-November, 2002.

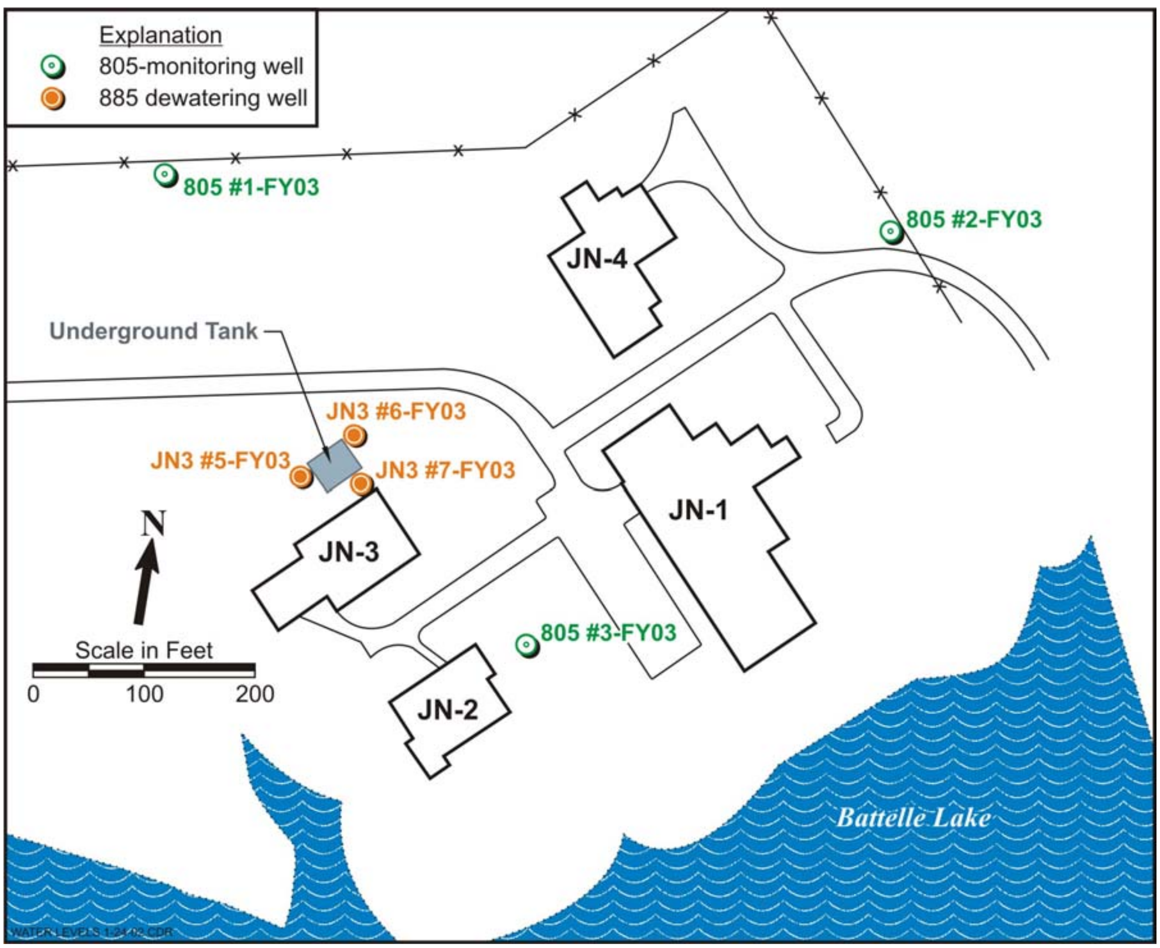

Figure 4. Locations and identification numbers of the first six wells to be installed in FY2003.

Table 2. Well construction parameters to be used in estimating costs.

Description	Number of wells	Approximate Total Depth (feet)	Well Diameter (inches)	I.D. of HSA (inches)	Screen Length (feet)	Approx. Sampling Intervals (ft bgs)
805-Sand Wells	3	110	4	6.25	5	20-30 and 50-60
885-Sand Dewatering Wells near to JN-3	3	30	6	8.25	25	20-30

4.2 805-Sand Monitoring Wells

Three wells will be installed in the 805-sand at distances of approximately 400 feet from one another. The wells will be approximately 110 ft deep. The well locations will be selected (by Battelle) to triangulate water levels in the unit and provide information on groundwater flow in the unit. Ground surface elevations at the well locations will be surveyed before well installation so that the 885-sand may be accurately logged. Split spoon sampling will be performed at one-foot intervals from approximately 20-30 ft below ground surface in the elevation interval 880- to 890 feet, 50-60 ft below ground surface in the elevation interval 850- to 860 feet and 100-110 ft below ground surface in the elevation interval 800- to 810 feet.

4.3 Dewatering Wells at JN-3

Three dewatering wells will be installed in the 885-sand surrounding JN-3. The purpose of these wells is to pump water from the 885-sand and the till above to reduce water levels around JN-3. The dewatering wells will be approximately 30 ft deep with 25-ft long screens to maximize water recovery. Groundwater inflow to these wells is expected to be very slow, perhaps on the order of 1 gallon per minute. Split spoon sampling will be performed from 880- to 890 feet elevation to identify the 885-sand.

4.4 Geotechnical Testing

Soil samples will be collected and analyzed for geotechnical properties. Analysis will include sieve analysis according to ASTM C-117 and C-136 methods. Porosity testing will also be performed on sand-rich samples. A report on grain size and porosity results will be provided in tabular and graphical format.

4.5 Surveying

The six well locations and elevations will be surveyed before and after well installation. The purpose of surveying the land surface before the well installations is to provide information on the probable depths to the sand horizons below ground surface. All surveying will be completed to an established benchmark (Well No. 206, an existing well). Well 206 will also be the 0,0 point for the local coordinate system in locating the 16 new wells. The results of this work will be compiled and included with the well completion and boring logs report.

4.6 Hydraulic Testing

Slug tests will be performed in the 805-sand wells after completion to determine the hydraulic conductivity of the materials surrounding the wells. The tests will consist of creating an abrupt change in water level within the well then monitoring water level recovery. The slug tests will be analyzed with industry-accepted methods and reported in the well completion and boring logs report.

4.7 Well Logs and Reporting

Formal boring/well logs will be provided after the completion of well construction, developing and testing. As such, geotechnical personnel will accompany the drilling crew. A complete well completion and boring logs report will be prepared to document all activities and results from the contracted work.

5.0 ADDITIONAL INFORMATION AND SPECIFICATIONS FOR DRILLERS

The following paragraphs describe monitoring well installation requirements, decontamination, and well development procedures that will be followed during drilling operations. Each well location will be selected and cleared for utilities before drilling begins. In addition, the locations will be surveyed for ground surface and easting and northing so that the two sand units may be detected when drilling (i.e. the 885-sand and 855-sand).

Qualified drillers accompanied by geotechnical personnel and supervised by Battelle staff will perform well installation. Hollow-stem auguring is the recommended drilling method. This will allow for soil sampling and proper well construction. Drilling cuttings will be contained pending RAL analysis. Figure 5 shows a basic well diagram of the proposed wells. The monitoring wells will be constructed with 4-inch (approx. 8 inch for the 4 dewatering wells), schedule 40 polyvinyl chloride (PVC) casings and screens. The screens will consist of 4-inch-diameter (or approx. 8 inch diameter), schedule 40 PVC with 0.01slots cut to the desired length of the screening interval. A sand pack consisting of No. 3 silica sand will be uniformly emplaced between the formation and the screen to 2-3 ft above the screen top. A transition zone of bentonite chips will be applied to the top of the sand pack. A cement/bentonite seal will be placed on top of the transition sand to ground surface. Centering guides will be used to maintain uniform sand pack and surface seal. The wells will be finished with a substantial concrete foundation and locking well monument to protect the surface stickup.

Large equipment, such as the drilling rig, will be decontaminated using high-pressure steam or hot water cleaners. All other non-disposable field equipment will be decontaminated to avoid cross-contamination between samples and to ensure the health and safety of the field crews. All tap water will be drawn from the potable municipal water supply available at Battelle.

All wells will be developed after installation. The static water level and initial pH, temperature, and specific conductivity will be measured at the beginning of development. Well development will be accomplished by first bailing accumulated sediment from the well. The well screen will then be surged slowly. Then the well will be purged with a submersible pump. As development proceeds, the quantity of water removed from the well and the measurements of pH, temperature, and specific conductivity will be recorded on a field log. Development will be considered complete when three consecutive measurements of pH, temperature, and specific conductivity taken for every one-half borehole volume (after the first borehole has been purged) vary by less than 10% (OEPA, 1995). Water produced during development will be collected and stored in a designated waste accumulation area for disposal, pending analysis. Well location and elevations will be surveyed upon completion.

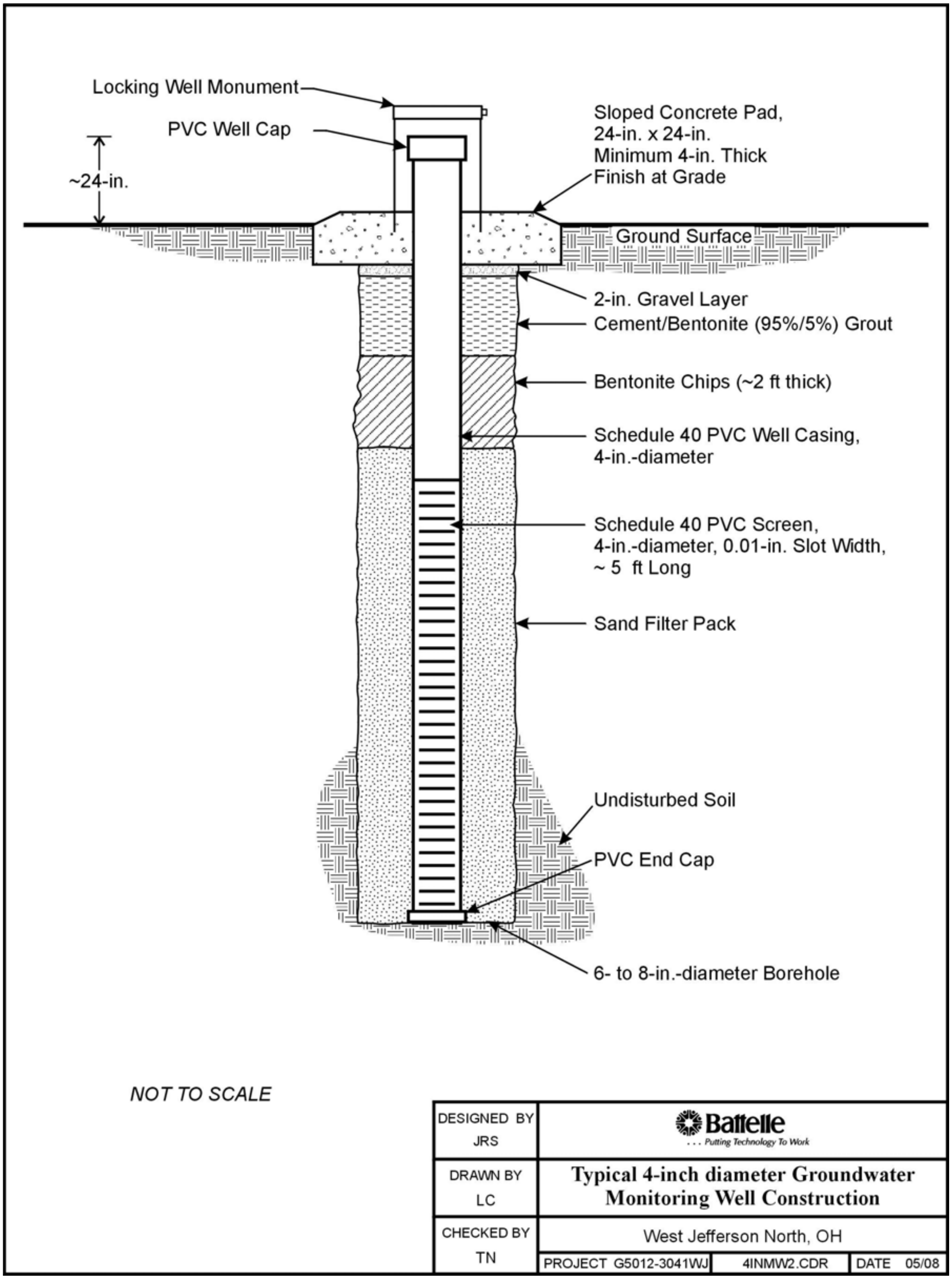

Figure 5. Schematic diagram for the construction of a 4-inch diameter groundwater monitoring well.

While drilling, soil samples will be collected from selected depths (as shown on Table 1) at 1 ft intervals with a split spoon sampler. Standard field procedures will be followed during sampling activities including sample collection and analytical requirements. Soil samples will be logged by a geologist and collected as sleeved cores using a split spoon core sampler. Samples will be sent to a qualified laboratory for grain-size analysis and porosity determination.

Slug tests will be performed in the new wells to determine the hydraulic conductivity of the sand units and till. The slug tests will consist of placing a pressure transducer and 1 3/8-inch-diameter by 3-ft-long or 1 5/8-diameter by 3-ft-long PVC slug within the well. After the water level reaches equilibrium, the slug will be rapidly removed. Water levels will be monitored by a pressure transducer and recorded by a Troll data logger. The data will then be downloaded to a laptop computer.

The recovery rates of the water levels will be analyzed with the Bower and Rice (1976, 1989) method for slug tests in unconfined aquifers and the Hvorslev (1951) method for slug tests in confined aquifer conditions. Graphs will be made of the change in water level versus time and manually curve fitted on a semi-logarithmic graph. The slope of the fitted line will then be used in conjunction with the well parameters to provide a value of the hydraulic conductivity of the materials within the screened interval of the well.

Prior studies have been performed at the site to identify or characterize radiation areas at the site. No drilling will be performed in any radiation areas. There is no need for radiological worker training to perform this work. A health and safety plan (HASP) for the BCLDP is maintained on site by Battelle. This HASP describes chemical hazards and personal protection equipment. Battelle will prepare a specific HASP for these drilling and well construction activities. A field activity manager will detail the HASP to all personnel on site before work begins. The HASP will be kept available in the field at all times. A 40-hour Occupational Safety and Health Administration (OSHA) hazardous worker training is required by all workers. Level D personal protective equipment (PPE) will be enforced. Battelle will monitor the drilling operations to ensure that only background levels (normal for central Ohio) of radiation are present.

6.0 JN-3 BASEMENT DEWATERING SYSTEM: SUMP WELLS AND TRENCH SUMPS

Dewatering prior to basement floor drain removal and demolition of JN-3 is necessary because of groundwater build-up around the building over the decades. Groundwater is actively seeping into the JN-3 basement at this time. Groundwater level monitoring and characterization activities have been conducted over the past year in order to supply background data for the development of a dewatering system for JN-3. These activities have concluded that it will be necessary to have operating systems outside of the building, as well as, in the basement itself. The outside system consists of four wells. The two wells on the north and east sides of the building will be particularly effective for dewatering around the foundation. Pumped water discharge from the outside system will be held in a tank, tested and discharged to the flood plain north of the dam. The pumped water from the basement system will be discharged into the two operating sumps in JN-3. This plan was prepared for the installation and operation of the internal system in the basement of JN-3.

Several low volume sump wells will be needed around the lowest structures in the JN-3 basement because of the low permeability of the fine-grained materials in direct contact with the cement. During construction gravel was not used around the footers and the reactor mat. If it had been used groundwater would have collected in the gravel much as a basement sump for a home collects water. If gravel was present the groundwater around JN-3 could now be readily pumped out in a fashion to an operating basement sump in a home. Because of a lack of gravel the spacing between sump wells will necessarily be much closer than if a more permeable material were around the foundation structures. Sump wells are fairly simple to build and are inexpensive mainly because they are not very deep. Several (tens) of these wells are common at construction sites. A 6 to 8 feet spacing of sump wells is recommended in the basement of JN-3. The sump wells will be located in clay rich deposits that were disturbed during construction as seen in the construction photos. Initially, approximately 35 sump wells will be used to draw down the water level in order to begin trenching around the drain lines. If water seeps into the bottom of the trenches during drain line removal, sumps (trench sumps) will be built and the trench itself will be a part of the water collection mechanism for the sump.

6.1 Subsurface Conditions in the JN-3 Basement

The general floor plan for the JN-3 basement structures is shown in Figure 6. The deepest and the wettest areas of the basement are in the upper left corner (the pump room) and around the reactor mat in the upper center of the figure. A vertically exaggerated cross-section through the basement floor and subsurface structures along the line A-A` is shown in Figure 7. The elevations of these structures in conjunction with the construction photos form the basis for sump well screen placement.

6.2 Sump Well Design

Two general designs of sump wells have been formulated for the basement: 1) the higher floor level design (Figure 8); and 2) the lower floor level design, i.e. in the pump room (Figure 9). Both designs require coring through the cement, auguring into the soil and constructing a shallow well by hand in the borehole. General construction dimensions are found on the diagrams, but will more than likely be altered by the actual conditions at each sump location.

6.3 Sump Well Construction

The major steps in building the sump well system include:

- Obtaining a discharge permit for the pump water routed to the pump room sump [Carl Brenner]
- Coring through the concrete at each sump location (12 inch diameter), [Carl Brenner]
- Auguring 3.5-6 feet into the soil below the concrete (8 inch diameter) [Carl Brenner]
- Centering 5-8 feet long, 6 inch diameter slotted PVC pipe (or comparable well screening) in the borehole [Tom Naymik will purchase materials and build sump wells]
- Placing gravel around the pipe [Tom Naymik will install sump wells and trench sumps]
- Installing pumps, connecting to common discharge lines and monitoring system performance [Tom Naymik]

Approximate sump well locations have been designated on a JN-3 basement plan view (Figure 10). Sumps are located along the deepest disturbed soil areas around the reactor mat and in the floor of the pump room where water is continually seeping up from the floor. Spacing between wells is 4 to 6 feet as these sumps are expected to have a limited radius of influence in the clay-rich material. Pumped water will drain into two common discharge lines leading to the sump in the boiler room and in the pump room.

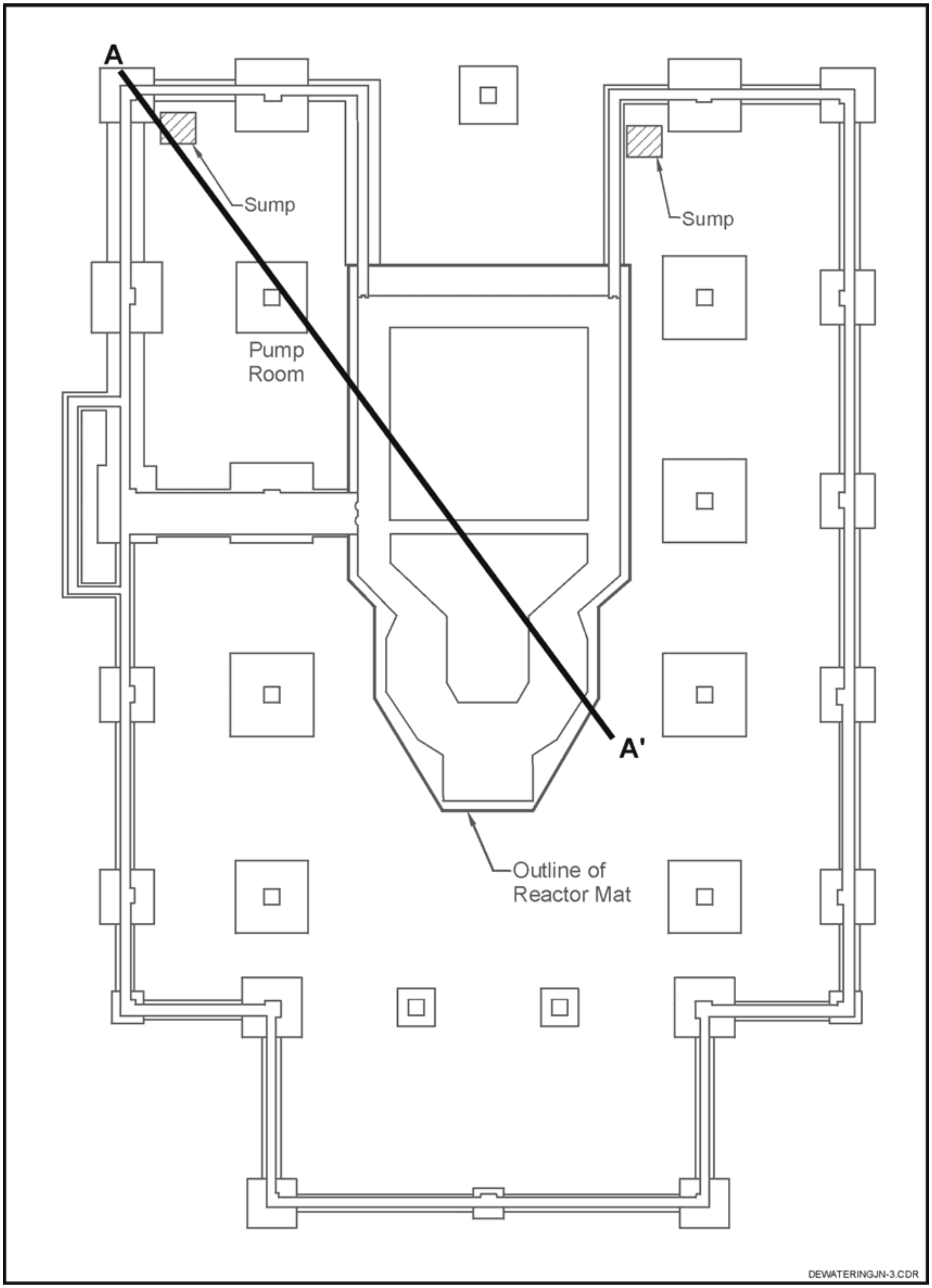

Figure 6. Location of cross-section A-A'.

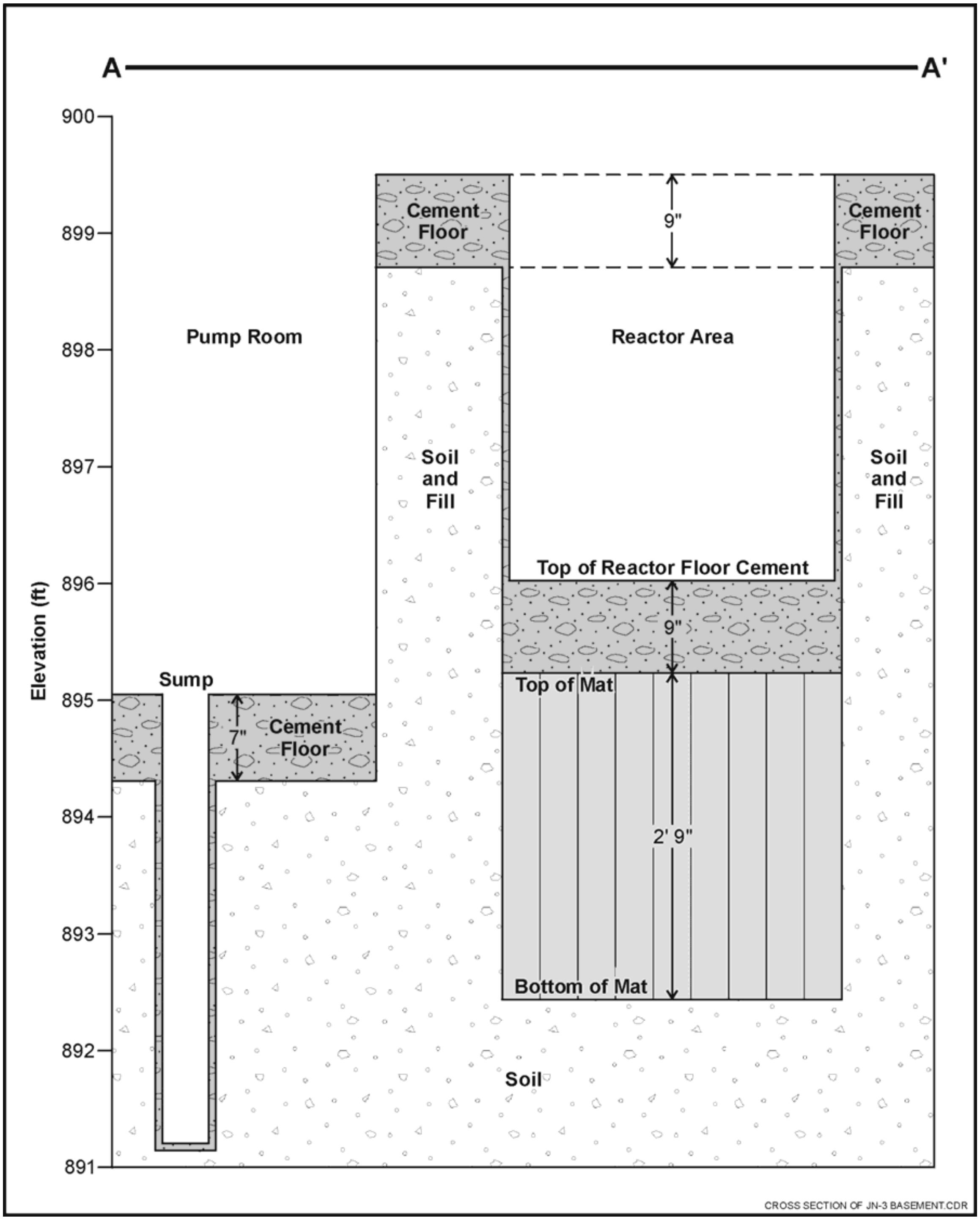

Figure 7. Cross-section A-A' (approximate).

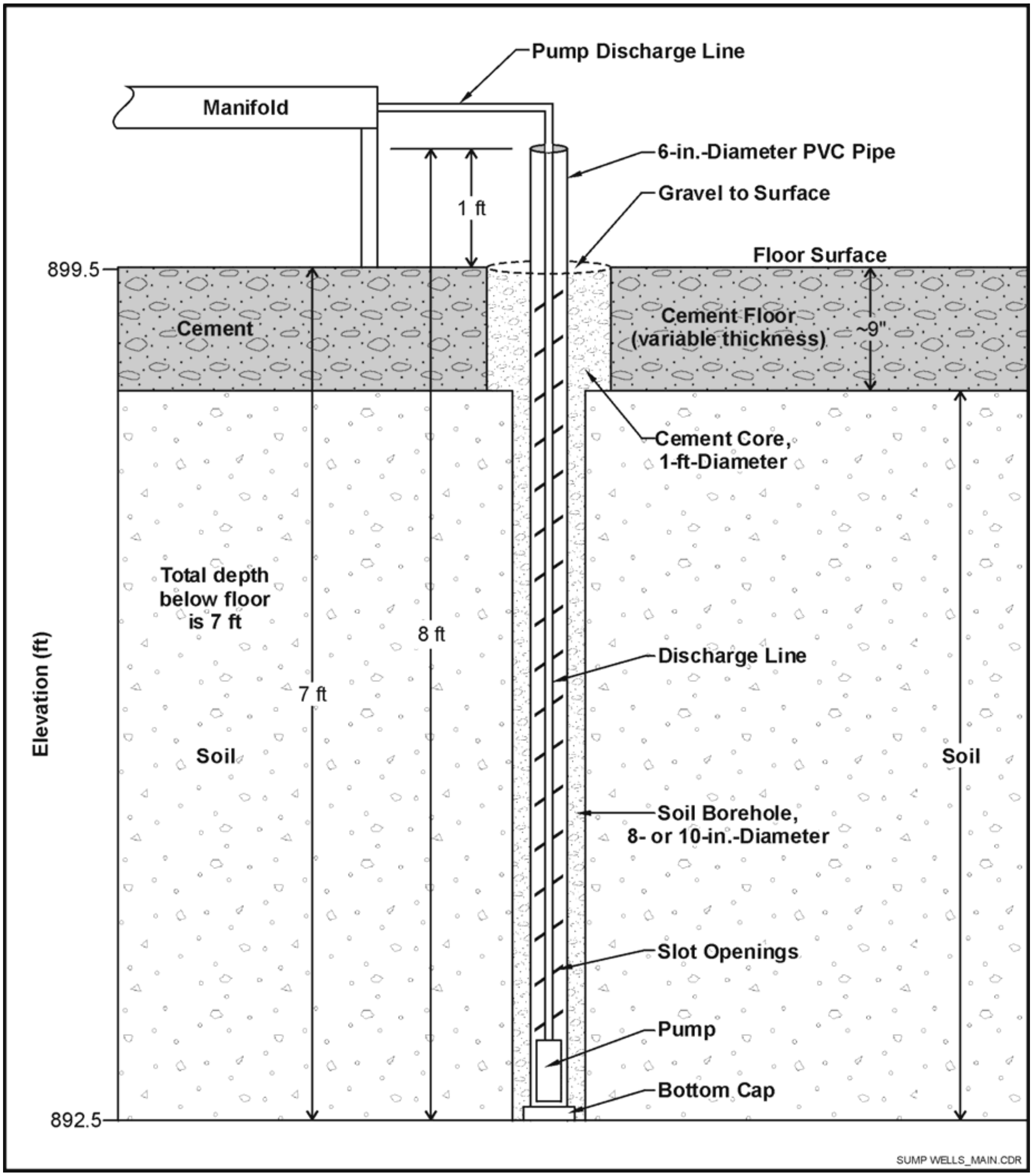

Figure 8. General design for sump wells around reactor mat and on the basement main floor area.

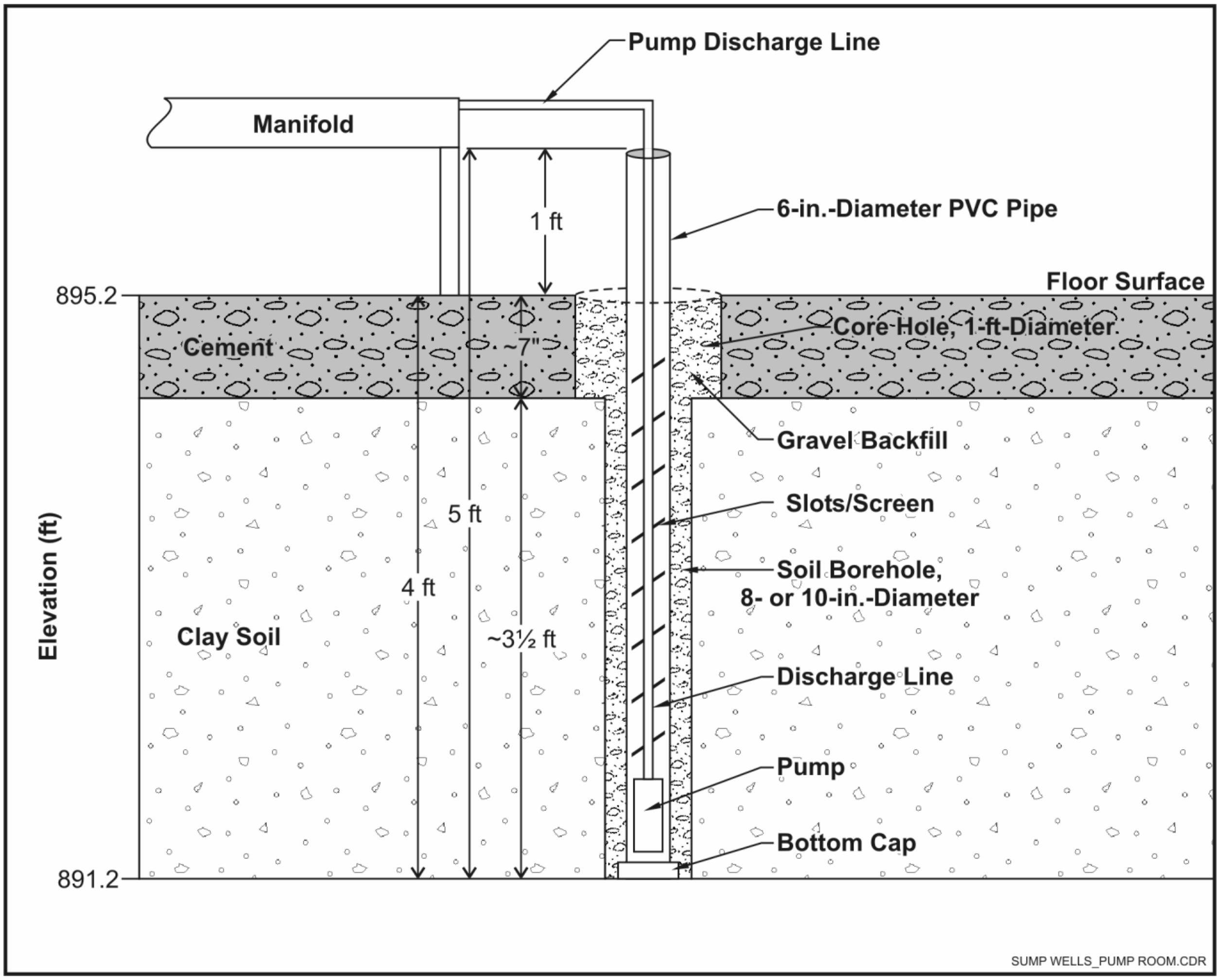

Figure 9. General design for sump wells installed in the pump room.

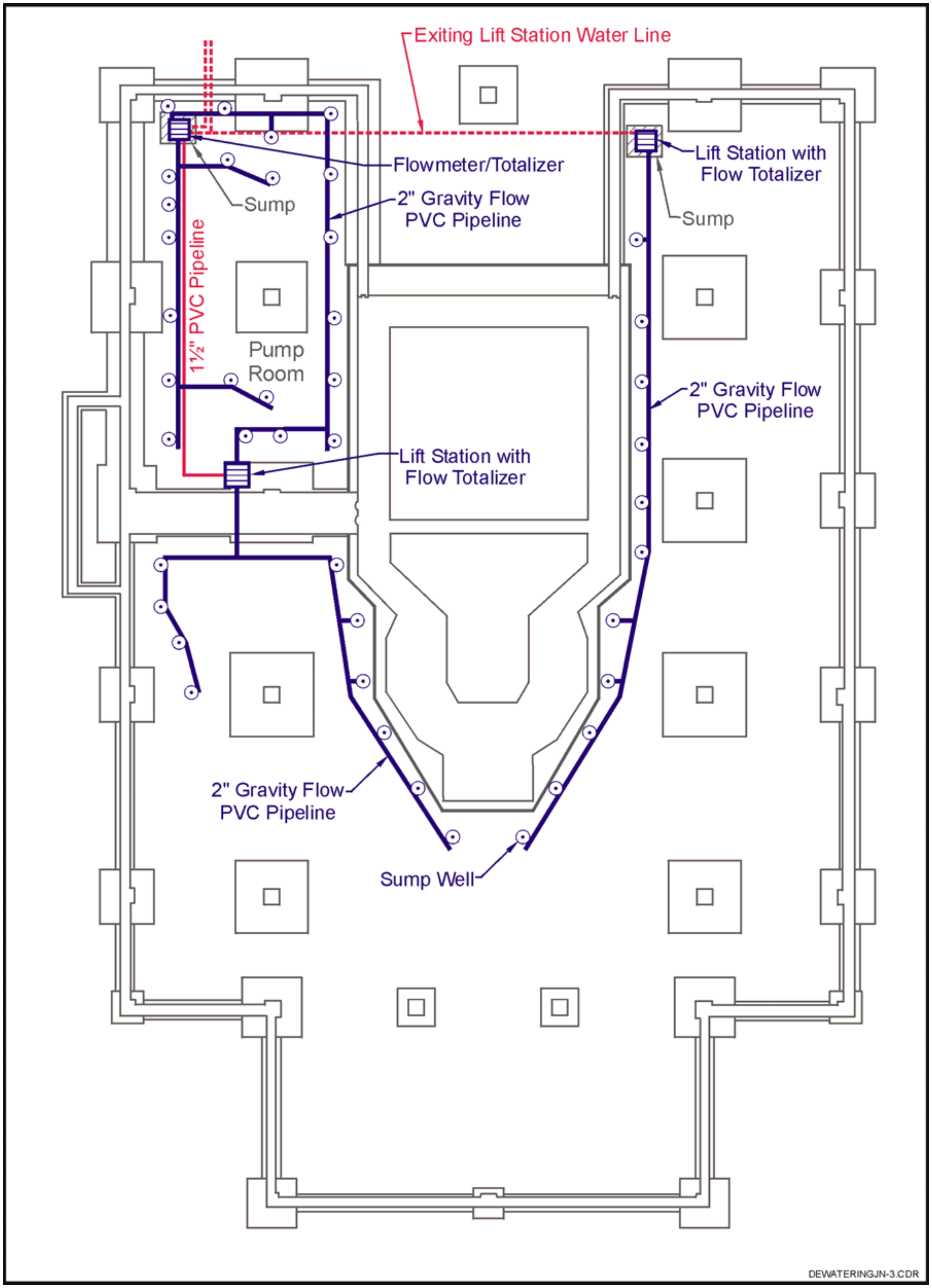

Figure 10. Planned sump well locations and piping manifold.

6.4 Trench Sumps

The center and northeast parts of the building are the wettest and will require continual sump well system operation prior to drain removal. Based on characterization information the floor drains in the western half of the building will not need a sump well system pumping prior to the onset of drain line removal. However, in these areas water is likely to slowly accumulate in the open trenches. When this occurs sump basins 2-3 feet deep will be built, similar to the sump well construction, in the bottom of the trench in effective locations. Discharge from the trench sumps will be connected to the sump well discharge lines.

6.5 Construction and Operation Schedule of the System

The schedule for JN-3 dewatering, construction and operation consists of five steps in series over the duration of 14 weeks.

1. Obtain discharge permit: 1 week
2. Borehole preparation (coring and auguring to total depth): 2 weeks
3. Sump well emplacement: 2 weeks
4. Pump installation and discharge line construction: 1 week
5. Dewatering and monitoring of system performance: 8 weeks

7.0 GROUNDWATER SEEPAGE INVESTIGATION IN THE RAVINES AND VALLEY WALL FOR BIG DARBY CREEK NORTH AND EAST OF THE SITE

Several sites in the DOE complex have utilized seep and spring characterization and monitoring to supplement monitoring well sampling programs. The technique becomes effective when the site is situated near to ravines, escarpments, or even large canyons. Infiltrated water on the facility proper recharges the groundwater flow system, migrates laterally and the more hydraulically conductive layers discharges to the surface as seeps and in some cases springs. The investigations have the potential for significant costs savings. Examples, of sites utilizing seep/spring investigations are: ORNL, ANL-E, LANL, and SRS.

During the summer of 2002, three wells were installed in the 885-sand horizon. Several water level measurements and triangulation have indicated the potential for flow toward the north at that elevation level. At this time the degree of physical connection or hydraulic communication among the sand units is not yet fully understood. However, it is likely that the units have had discharging groundwater along the ravines toward the north, east and south (prior to flooding the lake). In addition, now that the lake level is at a higher elevation than the sand units, the lake water is potentially providing a reservoir for groundwater recharge from the south. The recharging flow volume, however, is more than likely slight and occurs at an elevation below the basement levels of both JN-3 and JN-1.

The thin water-bearing horizons have now become important to the site as potential off-site migration pathways. Four elements of the potential pathway are: 1) downward groundwater seepage in the both the brown and gray till over the site; 2) sand channels/horizons providing avenues for horizontal groundwater flow (hydraulic conductivity of the sands is two to three orders of magnitude higher than the till); 3) thin sands may be potentially connected to the brown till along the ravines to the north and east and to the lake toward the south; and 4) Big Darby Creek floodplain immediately downhill from potential seep locations.

7.1 Objective

In 1966, thin water-bearing zones were identified in the till along the walls of pits dug to characterize the soil for use in the earthen dam (Burgess and Niple, 1966). The section of till containing the water-bearing horizons was exposed during the excavation of borrow pit No.1. The objective of the groundwater seepage investigation is to probe the till with the intention of identifying and characterizing potential horizons of groundwater migration. The horizons are important as possible discharge locations for shallow groundwater that has infiltrated though the soils in the fence area of the North Site. The information acquired from this investigation will be utilized for assessing potential risk from the site to off-site receptors through the groundwater pathway.

7.2 Conditions Northeast Of The Site

Borrow pit No. 1 is located northeast of the North Area (Figure 11) along the till escarpment leading to the Big Darby Creek floodplain. Figure 11 shows the general extent of the pit on pre-excavation elevation contour map. Former soil test pits are also located on the map. The land surface profile was changed from a naturally weathered slope to a much steeper excavated drop-off (Figure 12) along the southwestern edge of the borrow pit. The aerial photograph (1978) in Figure 12 shows small ravines created by direct down slope erosion along the southwestern lip of the pit. The horizons where seepage may occur are along that exposed area. Today the area is heavily vegetated with small trees and brush.

The flow chart in Figure 13 outlines the steps for the seepage investigation. The following sections provide a brief narrative for each step.

7.3 Modification Of Geological Block Model

The northern and eastern portions of Figures 11 and 12 lie outside of the current geological, 3-D block model. As part of this investigation the model will be extended to incorporate the information gathered from this work.

7.4 Evaluate The Till, Vegetation, And Slope Stability

The first step in the field work will involve several walkovers of the area noting the nature of the slope material and looking for indications of groundwater seepage. This study is planned for the late winter and early spring when groundwater discharge will be at its maximum potential.

7.5 Survey The 880 And 890 Feet Elevation Contours

The thin sand layers and the presence of water bearing horizons have been previously reported or recently seen during the drilling for the groundwater plan at elevations between 880 and 890 feet, in general. This ten-foot interval will be the initial target elevation in probing for seeps. This does not exclude areas of the slope above and below, but this interval will be identified and marked-off by a professional surveying team so that the geologists will have solid reference elevations for the investigation.

7.6 Determine Potential Groundwater Discharge Areas For Till/Seep Sampling

After the survey team has marked-off the 880-890 foot interval, the geologists will investigate the area for evidence of discharging groundwater. Hand-held tools, such as, probes, augurs and shovels will be used due to the difficulty of the terrain in the area.

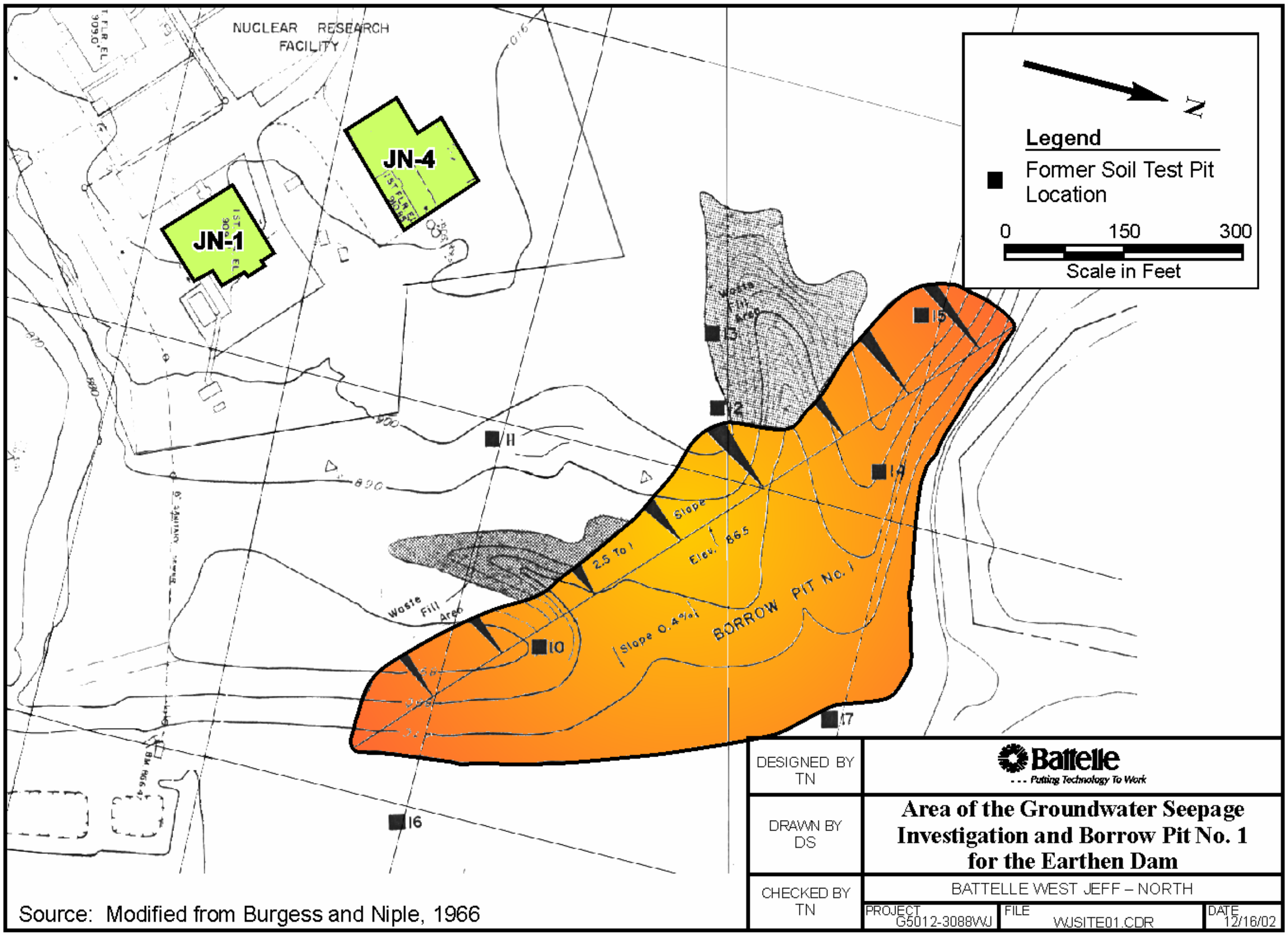

Figure 11. Area of the groundwater seepage investigation including borrow pit No. 1.

Figure 12. Aerial photograph (view toward the west, taken in 1978) of the investigation area. The northeast corner of the fenced area is shown in the upper left, borrow pit No. 1 is centered, and a portion of Big Darby Creek is seen in the lower right.

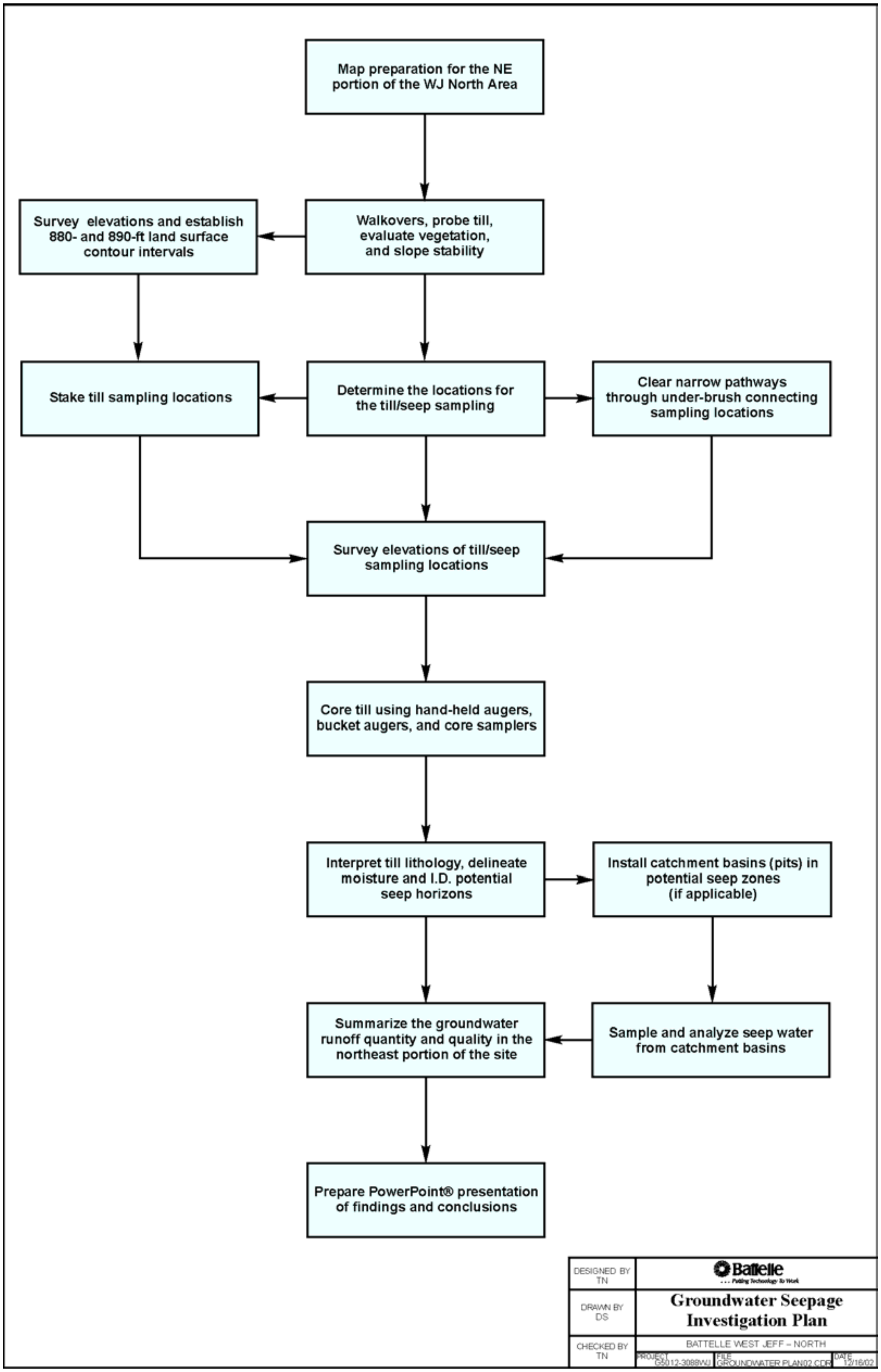

Figure 13. Flow chart of the groundwater seepage investigation plan.

7.7 Clear Underbrush And Stake Till Sampling Locations

Once candidate areas for discharging groundwater have been identified, the underbrush will be cleared out along paths connecting the areas. The candidate areas may range in size from a few square feet to several tens of square feet. Larger areas will more than likely be the case because of the softness of the material at the surface. In the large areas bigger and deeper auguring capability will be needed. Cleared pathways will be needed to accommodate the larger equipment.

The highest potential discharge locations will be staked for deeper auguring and catchment basin construction.

7.8 Core/Dig Till Using Hand-Held Equipment

The goal of this step is to find zones of heavy moisture or flowing groundwater in the till. The invasive methods will depend on the amount of rubble in the overburden, the resistance of the till, the steepness of the slope, etc. and will more than likely require a combination of auguring and digging. This is basically the seek and find activity.

7.9 Interpret Till Lithology

The geologist will log the till lithology for correlation with previous investigations and use during future subsurface activities in and around the North Site.

7.10 Install Catchment Basins (If Applicable)

Temporary plastic/rubber catchment basins will be emplaced if flowing, discharging groundwater is detected. The volume of water will be monitored and measured for quantity, flow rate and quality.

7.11 Sample And Analyze Seep Water

The water will be sampled by environmental monitoring staff according to project procedures and analyzed in the RAL. General water quality parameters will be determined with a field kit. If the flow rate exceeds 2-3 gallons per day, the seep will be added to the environmental monitoring program for routine determination of water quantity and quality.

7.12 Survey Elevation(s) Of Till/Seep Sampling Locations

The survey crew will be brought back to determine the elevations of the discharging zones. It is necessary to have exact elevations of the horizons so that they may be correlated with information gathered previously in the well boring logs.

7.13 Powerpoint® Presentation Of Findings And Conclusions

Two deliverables will result from this investigation: 1) Daily reports of the field operations combined with the geological logs of the overburden materials and the till will be entered into the BCLDP records and 2) A PowerPoint® presentation will be created describing the results of the investigation and summarizing their implications to the BCLDP.

8.0 SPRING FY 2003 WELL INSTALLATIONS AND FIELD ACTIVITIES

The overall purpose for groundwater monitoring and testing at the Battelle West Jefferson North Site is to characterize the groundwater system, particularly in vicinity of buildings JN-1 and JN-3, in support of dewatering operations. Additionally, the wells are used to provide a means of assessing geological horizons that may serve as pathways for migration of contamination. Previous well installations of the Groundwater Plan have allowed for the collection of water level data used to estimate the flow directions and flow rates of groundwater in the three predominant sand horizons. In addition, those wells have yielded data to aid in the design of the dewatering system for the basement of JN-3. Currently, flow directions have been estimated for the three sands and the focus of the plan is now on the installations of monitoring wells into the sand units in the down-gradient direction of facilities having the potential for groundwater contamination. Another near-term focus is the management of the groundwater levels in the vicinity of JN-1 that may interfere with the demolition of the building.

8.1 Objectives

The purpose for the well installations and groundwater activities during the Spring of 2003 is twofold. The first purpose is to emplace monitoring wells down-gradient of potential sources of contamination and to able to confirm that those facilities and groundwater pathways present no risk to human health or the environment and present no liability to Battelle from the off-site migration of contaminants. The second purpose is to acquire the background hydraulic information needed for assessing the groundwater situation in the area of JN-1 for future dewatering planning prior to demolition of the building.

There is known shallow soil contamination around JN-1. These sources could have contaminated shallow groundwater very locally, but do not represent a risk via the groundwater pathway. Of more concern in the JN-1 area is the 855 ft elevation sand layer that is possibly intersected by the construction excavation associated with the pool in the building. This sand layer is continuous over the whole area underlying the North Site. With the downward flow potential of groundwater in the area there is some potential for past drain line leakage, possibly occurring under the basement floor of JN-1 to migrate downward and into the 855-sand (and the 885 ft sand horizon where present). In addition, through recent water level monitoring the 855-sand was found to be in hydraulic communication with the groundwater in limestone bedrock. For these reasons JN-1 facility (in combination with the North Well) will be monitored in the down-gradient flow direction in each of the sand units. Other facilities at the North Site essentially have no potential for migration (no completed pathway) off-site through the groundwater flow system.

To accomplish these objectives, wells will be installed in the locations shown on Figure 14, tested and monitored for hydraulic parameters and radiological chemicals. Two 855-sand wells will be located toward the northwest of JN-1 in the down-gradient shadow of the facility and the North Well. Five 885-sand wells will be needed for monitoring purposes because of the uncertainty of the presence of the units and the variable flow directions in the horizon. These wells will also be used to gather hydraulic information for dewatering planning. A three-well cluster will be installed to assess vertical gradients in the JN-1 vicinity and any gradients that have been altered or established by pumping of the North Well. The basal sand well of the cluster will be located for the joint purpose of monitoring down-gradient of JN-1/North Well. Therefore the following 10 wells will be installed:

- Two 855-sand layer monitoring wells (60 ft deep),
- Five 885-sand wells around JN-1 (30 ft deep)
- One 3-well cluster comprised of; One 885-sand layer monitoring well (30 ft deep), one 855-sand layer monitoring well (60 ft deep) and one basal sand layer monitoring well (~170 feet deep).

Table 3 summarizes the well construction details. Continuous split spoon soil sampling will be performed in selected intervals during hollow stem auger (HSA) drilling. The samples will be retained for geotechnical testing and the required RAL (Radiological Analysis Laboratory) analysis to be performed by Battelle. Geotechnical testing to be included in the bid will consist of porosity determination and grain size analysis (ASTM C-117 & C-136). Once the wells are completed, hydraulic (slug) testing will be performed in the basal sand and 855-sand wells to determine the hydraulic conductivity of the units. In general, the portions of the site where this work will be performed contain paved roads and the area is flat. The planned start time for this work is early to mid-April 2003.

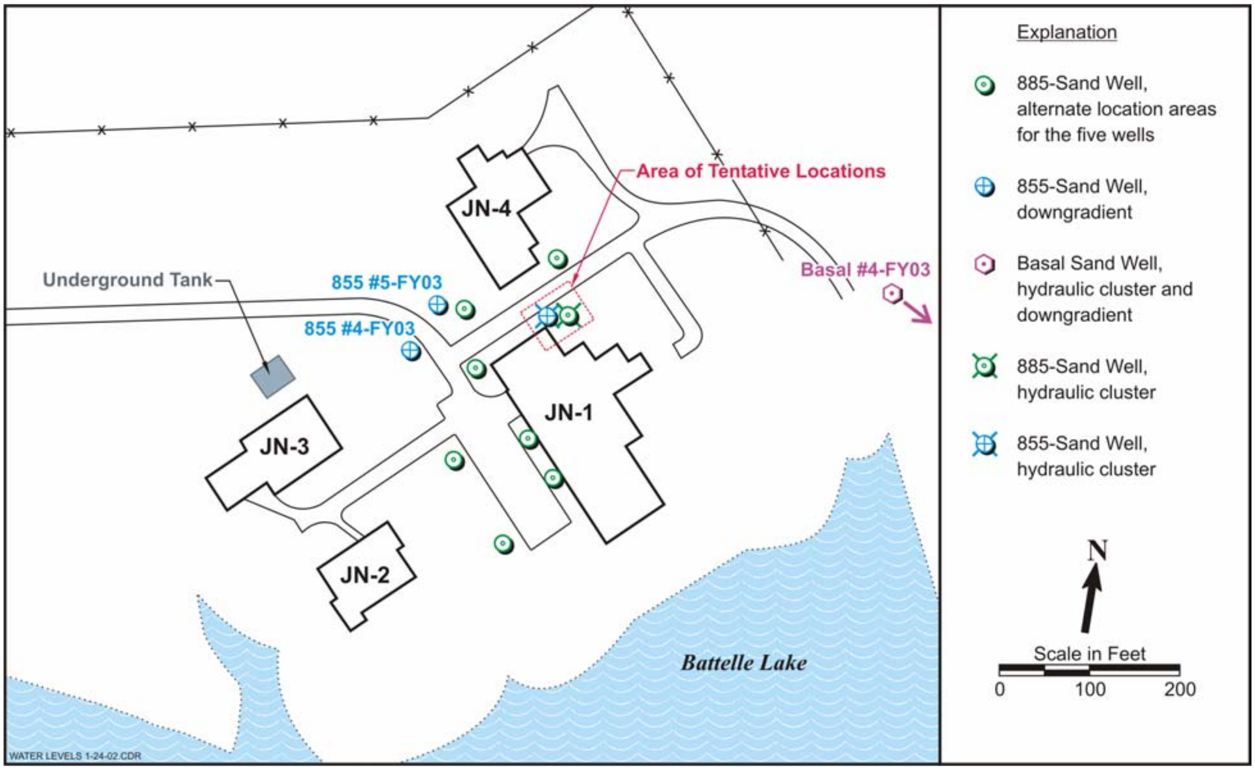

Figure 14. Tentative locations of new wells and alternate location of the 885-sand wells.

Table 3. Summary of well construction parameters.

Description	Number of wells	Approximate Total Depth (feet)	Well Diameter (inches)	I.D. of HSA (inches)	Screen Length (feet)	Approx. Sampling Intervals (ft bgs)
885-Sand Wells near to JN-1	5	30	6	8.25	25	20-30
855 Sand Well	2	60	4	6.25	5	20-30 and 50-60
885-Sand Well (in 3-well cluster)	1	30	6	8.25	25	20-30
855-Sand Well (in 3-well cluster)	1	60	4	6.25	5	20-30 and 50-60
Basal-Sand Well (in 3-well cluster)	1	170	1	3.25	5	20-30 and 50-60

8.2 Down-Gradient Monitoring Wells in the 885-Sand

Five wells will be installed in the near vicinity of JN-1 in order to monitor the 885-horizon sand channels in the area, monitor the brown/gray till water-bearing interface, and possibly contribute to a dewatering system around the building in the future. Split spoon sampling will be performed at one-foot intervals from approximately 20-30 feet below ground surface in the elevation interval 880- to 890 feet.

8.3 Down-Gradient Monitoring Wells in the 855-Sand

Two wells will be installed in the 855-sand at distances of approximately 100 feet from one another in the down-gradient direction from JN-1. The wells will be approximately 60 ft deep. The well locations will be selected (by Battelle) in order to monitor the down-gradient flow from the JN-1/North Well area and provide additional information on groundwater hydraulics in the unit. Ground surface elevations at the well locations will be surveyed before well installation so that the 855-sand may be accurately logged. Split spoon sampling will be performed at one-foot intervals from approximately 20-30 ft below ground surface in the elevation interval 880- to 890 feet and 50-60 ft below ground surface in the elevation interval 850- to 860 feet.

8.4 Three Well Cluster

A three-well cluster will be installed to assess vertical gradients in the JN-1 vicinity and any gradients established by pumping of the North Well. The basal sand well of the cluster will be located for the joint purpose of monitoring the groundwater of the unit down-gradient of JN-1/North Well. Continuous split spoon sampling will be conducted in the elevation interval 880-890 ft in each of the three wells and sampled in the 850-860 interval in the two deeper wells.

8.5 Geotechnical Testing

Soil samples will be collected and analyzed for geotechnical properties. Analysis will include sieve analysis according to ASTM C-117 and C-136 methods. Porosity testing will also be performed on sand-rich samples. A report on grain size and porosity results will be provided in tabular and graphical format.

8.6 Surveying

The six well locations and elevations will be surveyed before and after well installation. The purpose of surveying the land surface before the well installations is to provide information on the probable depths to the sand horizons below ground surface. The results of this work will be compiled and included with the well completion and boring logs report.

8.7 Hydraulic Testing

Slug tests will be performed in the 855-sand and basal-sand wells after completion to determine the hydraulic conductivity of the materials surrounding the wells. The tests will consist of creating an abrupt change in water level within the well then monitoring water level recovery. The slug tests will be analyzed with industry-accepted methods and reported in the well completion and boring logs report.

8.8 Well Logs and Reporting

Formal boring/well logs will be provided after the completion of well construction, developing and testing. As such, geotechnical personnel will accompany the drilling crew. A complete well completion and boring logs report will be prepared to document all activities and results from the contracted work.

9.0 CONTINUOUS WATER LEVEL MEASUREMENTS, BASELINE WATER QUALITY MONITORING AND INTERPRETATION

Data from all of the wells involved in the Groundwater Plan have been and will continue to be continuously collected from the wells, lake and creek and interpreted for the purposes of demolition dewatering and risk evaluation. Water levels in wells are recorded either continuously by data logger or on a routine basis through manual measurements for the purpose of developing and maintaining hydrographs for each well. Routine water quality parameters, such as, pH, dissolved oxygen, total dissolved solids, etc are measured routinely and maintained in a database to help and/or corroborate with hydrogeological interpretations of the site. All information is organized and maintained in order to develop and present hydrogeological interpretations necessary to support the BCLDP.

10.0 REFERENCES

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